Method for the Controlled Humidification of Indoor Air

This invention relates to a process for the controlled humidification of indoor air using water-containing, dimensionally stable compositions which contain alkali metal carboxylates, water and optionally other additives.

External factors, such as light, temperature and air humidity, play a major role in the well-being of people who spend time indoors. In air-conditioned (i.e. heated or cooled) rooms in particular, the use of heating or cooling installations generally leads to a drastic reduction in the humidity level of the indoor air. In rooms or buildings with air conditioning, this effect is generally supported by the fact that the windows must not be opened so that the room or the building cannot be directly supplied with fresh air. However, similar problems also often arise in heated living rooms where, particularly in winter, dry heating air circulates in the room which, in addition, is not ventilated sufficiently often in order to save energy or because of sensitivity to the cold. In cases such as these, the winter air, which is mostly dry anyway, is further reduced in its humidity by the heating of the rooms. People who spend time in such rooms where the indoor air has low humidity often suffer from complaints such as burning eyes, dry, tight and - in many cases - even irritated skin and breathing difficulties manifested in pains in the lower and upper respiratory tracts, for example bronchial pains, neck pain or increased susceptibility to colds.

Hitherto, phenomena such as these have mainly been prevented in two ways which often involve serious disadvantages.

For example, open humidifying containers filled with water have been placed near radiators and heating systems with a view to releasing their water into the environment more or less under control. However, the handling of such containers, particularly when they are filled with water,

generally results in frequent spilling of the water during placement or filling of the container. This in turn often leads to rusting of the heating unit or damage to the substrate. The second of these two phenomena is a particular disadvantage in rooms with sensitive or expensive floors, for example wood block floors.

Another widely practised method of humidifying rooms is to install an electrical appliance which releases water vapor. However, it is well-known that appliances such as these often tend to become fouled by algae, bacteria and molds. Accordingly, the water aerosol particles released into the indoor air are in danger, for example, of entraining microorganisms which might cause diseases. In addition, appliances of the type in question frequently take up a large amount of space, i.e. they often disturb the aesthetics of the room or are disagreeably noisy in operation. In addition, these appliances operating with "liquid" water also involve the risk of water spillages during filling or accidental overturning of the appliance. Moreover, electricity is always needed.

In addition, both these methods of room humidification have the disadvantage that the constant evaporation of water leads to a build-up of limescale in the water container which can result over a more or less long period in the unserviceability of the container or at least in the need for regular descaling by the user.

Accordingly, the problem addressed by the present invention was to provide a process for the controlled humidification of indoor air which would not have any of the disadvantages mentioned above.

It has now been found that water-containing shaped bodies consisting of a dimensionally stable composition containing alkali metal carboxylates of C_{8-26} carboxylic acids and water enable indoor air to be humidified under control without any of the above-mentioned disadvantages arising.

Accordingly, the present invention relates to a process for the

controlled humidification of indoor air or an indoor air supply, in which a water-containing shaped body is exposed to the indoor air or indoor air supply to be humidified, the water-containing shaped body being a dimensionally stable composition containing 1 to 40% by weight of alkali metal carboxylates of C_{8-26} carboxylic acids and 60 to 99% by weight of water.

Accordingly, the dimensionally stable composition used as the water-containing shaped body has a high water content, this water being released under control and - so far its release rate is concerned - adjustably within certain limits.

The dimensionally stable composition contains about 1 to 40% by weight of alkali metal carboxylates of C_{8-26} carboxylic acids as its principal structuring component. Fatty acids such as these are obtainable, for example, from fatty substances occurring in nature, more particularly as vegetable and animal fats and oils. Generally speaking, these "soaps" also have an antimicrobial effect which means that microbes, such as fungi, bacteria or algae, do not infest the surface of the shaped body to any significant extent, if at all.

Vegetable and animal oils and fats occur in nature in the form of natural mixtures of various fatty acid glycerol esters, for example in the form of palm oil, palm kernel oil, palm stearin, olive oil, rapeseed oil, coriander oil, sunflower oil, cottonseed oil, peanut oil, linseed oil, lard oil, fish oil, train oil or lard.

The naturally occurring fats do not generally yield identical fatty acids, but mixtures of fatty acids with different chain lengths, branches, functional groups or unsaturated molecule sections. The term "fatty acid cuts" is generally used for such mixtures. The dimensionally stable composition according to the invention may be based both on alkali metal salts of pure fatty acids (fatty acids with the same molecular structure) and on alkali metal salts of fatty acid cuts. Good results can generally be

achieved with both variants. However, a preferred embodiment is characterized by the use of alkali metal salts of carboxylic acids from fatty acid cuts, more particularly from fatty acid cuts predominantly containing fatty acids with about 12 to about 22 carbon atoms.

Examples of basically suitable carboxylic acids containing about 8 to 26 carbon atoms and preferably about 12 to 22 carbon atoms are caproic, caprylic, capric, lauric, myristic, palmitic, stearic, arachic, behenic, cerotic, pentadecanoic, margaric, tridecanoic and lignoceric acid. Examples of unsaturated fatty acids containing about 8 to 26 carbon atoms and preferably about 12 to 22 carbon atoms are myristoleic, palmitoleic, oleic, elaidic, petroselic, erucic, linolic, linoleic, arachidonic, clupanodonic, docosahexaenoic, eicosapentaenoic and gadoleic acid.

By virtue of their high natural content of saturated fatty acids, a preferred embodiment of the present invention starts out from alkali metal salts of carboxylic acids from fatty acid cuts based on coconut oil, palm kernel oil or bovine tallow.

Basically, carboxylic acid salts of the alkali metals Li, Na, K, Rb, Cs may be used in accordance with the invention either individually or in the form of a mixture of two or more thereof. However, carboxylic acid salts of the alkali metals Li, Na, K, more particularly the Na carboxylates, are preferably used.

The dimensionally stable compositions according to the invention contain the alkali metal carboxylates of the above-described type in quantities of preferably about 2 to about 10% by weight and more particularly about 3 to about 8% by weight. Preferred carboxylic acids are myristic, palmitic and stearic acid which may be used directly as corresponding salts or, for example, after neutralization with NaOH.

Accordingly, in a preferred embodiment of the invention, the dimensionally stable composition contains about 2 to about 10% by weight of Na C_{12-22} carboxylate and about 70 to about 98% by weight of water.

Besides the above-mentioned alkali metal carboxylates and water, the dimensionally stable composition to be used in the process according to the invention may also contain 0 to about 20% by weight of an additive selected from the group consisting of solvents, regulators, perfumes, insecticides, preservatives, thickeners or moisture indicators or a mixture of two or more thereof.

Suitable solvents are, for example, any water-soluble solvents, for example short-chain alcohols containing about 2 to about 8 carbon atoms.

In a preferred embodiment, the composition is formulated with virtually no solvent. However, small amounts may be introduced, for example, through additives (for example perfume oils).

The dimensionally stable composition to be used in accordance with the invention may also contain regulators. A regulator in the context of the invention is understood to be a compound with which the vapor pressure of the water present in the dimensionally stable composition can be adjusted within certain limits. Suitable regulators are, for example, non-hygroscopic salts, such as NaCl, or hygroscopic salts, such as $CaCl_2$ or Na_2SO_4, and swellable substances, for example clays, silica gels, molecular sieves or polyalcohols. The regulators mentioned may be used either individually or in the form of a mixture of two or more. The regulators may be present in the air humidifier both in finely dispersed dissolved form or in coarsely dispersed form (for example granules).

Suitable polyalcohols are, for example, alcohols containing two or more OH groups and up to about 30 carbon atoms, for example ethane-1,2-diol, propane-1,2-diol, propane-1,3-diol, butane-1,4-diol, butane-2,3-diol, pentane-1,5-diol, hexane-1,6-diol, octane-1,8-diol, diethylene glycol, neopentyl glycol, 1,4-bishydroxymethyl cyclohexane, 2-methylpropane-1,3-diol, hexane-1,2,6-triol, glycerol, diglycerol, polyglycerol, trimethylol propane, trimethylol ethane, pentaerythritol, sorbitol, methyl glycoside, dimer diol, trimer triol, glucose, alkyl polyglycosides and di- and

polysaccharides. The alcohols mentioned may also be present in the dimensionally stable composition as EO or PO addition products with or without a sulfonic acid group. Lactams, such as ε-caprolactam, may also be used as regulators.

Through the presence of regulators, the amount of water released per unit of time can be limited to a certain extent, depending on the external conditions and on requirements.

In addition, the dimensionally stable composition may contain perfumes. Perfumes in the context of the present invention are odoriferous substances which produce a pleasant fragrance or which improve the general conditions. In the context of the invention, the term "perfumes" also encompasses essences and aromas, for example healing or healing-promoting perfumes, such as the essential oils.

Particularly suitable perfumes are described, for example, in E. Ohloff's reference book entitled **"Riechstoffe und Geruchsinn" (ISBN 3-540-5256-2, Springer Verlag)** from 1990. Suitable perfumes are, for example, vegetable perfumes, petrochemical or animal perfumes. Such perfumes as orange peel oil, sandalwood oil or frankincense may be used, depending on the intended location of the air humidifier (for example bathroom or bedroom).

The dimensionally stable composition usable in accordance with the invention may also contain insecticides or repellents. The insecticides guarantee long-lasting control of, for example, flies, gad-flies, mosquitoes, cockroaches, bugs or fleas which have a harmful effect, for example as carriers of diseases. The dimensionally stable composition may also contain insecticides of which the effect is directed primarily against plant pests. This is particularly recommended when the dimensionally stable composition is used, for example, to maintain a certain humidity in rooms used for growing useful or ornamental plants.

According to the invention, some of the perfumes mentioned in the

above-cited reference book (for example clove oil, cinnamon oil, mustard oil), dimethyl phthalate, benzoic acid diethylamide, phenyl cyclohexanone, ethyl hexanedial, chlorinated hydrocarbons (for example DOT), phosphorus compounds, carbamates, nicotine or mineral oils, for example, may be used as insecticides or repellents. Toxicologically safe insecticides or repellents should be used, depending on the location of the air humidifier.

The dimensionally stable compositions may additionally contain thickeners which can contribute, for example, to the dimensional stability of the composition. Basically, suitable thickeners are organic high molecular weight substances which absorb water and swell in the process. Examples of organic natural thickeners are agar agar, carrageen, tragacanth, gum arabic, alginates, pectins, polyoses, guar gum, locust bean gum, starch, dextrins, gelatine, casein and the like. Organic modified natural materials, for example carboxymethyl cellulose and homologous cellulose ethers, hydroxyethyl and hydroxypropyl cellulose, gum ethers, starch derivatives and the like, may also be used.

Organic fully synthetic thickeners include, for example, polyacrylic and polymethacrylic compounds, vinyl polymers, polycarboxylic acids, polyethers, polyamides and polyurethanes. Inorganic thickeners, for example polysilicic acids, clay minerals, such as montmorillonites, zeolites or silicas, may also be used. The thickeners mentioned may also serve as regulators in that they influence the evaporation rate of the water.

The dimensionally stable compositions may also contain dyes or pigments - or mixtures thereof - which generally have a decorative function, but may also perform a warning or informative function. The dyes or pigments or mixtures thereof may be uniformly distributed as coloring components in the dimensionally stable composition. However, the coloring components may also be applied solely to the surface of the dimensionally stable composition. The dimensionally stable compositions may then be used, for example, as a decorative room element or as an

advertizing medium.

Suitable dyes or pigments are, for example, any water-soluble or water-dispersible, ecologically safe substances.

The dimensionally stable compositions may additionally contain moisture or freshness indicators which visually display the residual water content of the dimensionally stable composition or indicate whether the pack was opened before its intended use. For example, such indicators may be used in conjunction with a suitable optical measuring system for determining the water content of the dimensionally stable composition, even when it is located in inaccessible places, for example in a ventilation system or in an air conditioning system, without any need for time-consuming and inconvenient measures, for example the opening of a ventilation system.

Suitable moisture and freshness indicators are, for example, indicator dyes, such as phenolphthalein or thymolphthalein, or salts which change color through changes in the water of crystallization (for example Co salts).

The dimensionally stable compositions may be produced in various ways. For example, the alkali metal soaps of the above-mentioned carboxylic acids may be dissolved in water at temperatures above about 50°C. The dimensionally stable compositions to be used in accordance with the invention are then formed on cooling. However, it is also possible to heat fatty acids or fats and to carry out the saponification by addition of a suitable alkali metal salt, for example an alkali metal hydroxide. If such a mixture is left to cool, the dimensionally stable compositions are again formed.

One advantage of the invention is that, because they are easy to make, the dimensionally stable compositions may assume virtually any shape including, for example, blocks, spheres, cubes, bars, discs, figures and the like. The evaporation rate of the water can also be controlled as

required through the surface of the shaped body. The solid soap structure is of advantage in this regard, i.e. the shaped bodies do not coalesce with time. It is also possible, for example for use in ventilation systems, to pour the dimensionally stable compositions in liquid form into certain holders which, after the composition has solidified, enable it to be used easily in suitable devices. After evaporation of the water and other volatile ingredients from the dimensionally stable composition, all that remains is a mixture of alkali metal carboxylates and nonvolatile additives, if any. A residue such as this may be subsequently used, for example, in a hand or body wash. However, the residue may also be suitably processed and reused for the production of a dimensionally stable composition.

Accordingly, in one preferred embodiment of the invention, the dimensionally stable composition is placed on a suitable support in a room filled with air to be humidified or is exposed in a suitable holder or pack to a stream of an indoor air supply to be humidified. In another preferred embodiment of the invention, the stream of an indoor air supply to be humidified is heated or cooled before, during or after humidification.

The present invention also relates to the use of a dimensionally stable composition containing 1 to 40% by weight of alkali metal carboxylates of C_{8-26} carboxylic acids and 60 to 99% by weight of water, more particularly a dimensionally stable composition containing 2 to 10% by weight of Na C_{12-22} carboxylate and 70 to 98% by weight of water, for humidifying indoor air or an indoor air supply.

In a preferred embodiment of the use according to the invention, the dimensionally stable composition contains 0 to 20% by weight of an additive selected from the group consisting of solvents, regulators, perfumes, insecticides, thickeners, dyes, pigments and moisture indicators or a mixture of two or more thereof.

In the use according to the invention, the dimensionally stable composition is placed on a suitable support in a room filled with air to be

humidified or is exposed in a suitable holder or pack to a stream of an indoor air supply to be humidified.

The following Examples are intended to illustrate the invention.

Examples

	Example 1	Example 2	Example 3
Na myristate	4%	1%	3%
Na palmitate	2%	-	0.99%
Na stearate	-	4%	3%
Perfume (perfume oil)	0.01%	-	-
Glycerol	9.99%	5%	-
ε-Caprolactam	1%	-	-
Phenolphthalein	-	-	0.01%
Water	83%	90%	93%
Adjusted pH value	8	9	10.9

All the components are taken up in water heated to 70°C and homogenized (at the same temperature). The pH is adjusted (if necessary) to a value of 7 to 11 by adding small amounts of NaOH. The low-viscosity liquids may be poured into molds and solidify below 50°C. Shaped bodies can be subsequently produced from blocks.

Properties of the shaped bodies of Examples 1 to 3

The shaped bodies of Examples 1 and 2 are whitish in color. By contrast, Example 3 gives bluish-lilac shaped bodies. If packed shaped bodies of Example 3 are removed from their air-tight and waterproof packs, their surface loses color after a few minutes (change in pH by uptake of CO_2). The user can see that the system was unopened and begins work.

Depending on the in-room location, the temperature, the air humidity

present, the quantity and geometry of the shaped bodies, the size of the room and the change of air, the Examples give off moisture and perfume (Example 1) to the surrounding environment for a few days to several weeks. Example 1 lasts about 20 to 30% longer than Examples 2 and 3 and, after drying out, forms an opaque soap which may be used, for example, for washing the hands. The residues of Examples 2 and 3 are white and may be used for the same purpose. After drying out, the shaped bodies are neither soiled nor covered in germs.